

AD-A262 076



ATION PAGE

TRICTIVE MARKINGS

1a. REPORT SECURITY CLASSI

Unclassified

2a. SECURITY CLASSIFICATION AUTHORITY
N/A

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE
N/A

4. PERFORMING ORGANIZATION REPORT NUMBER(S)

NDU-ICAF-92-*A 79*

6a. NAME OF PERFORMING ORGANIZATION
Industrial College of the
Armed Forces

6b. OFFICE SYMBOL
(if applicable)
ICAF-FAP

6c. ADDRESS (City, State, and ZIP Code)
Fort Lesley J. McNair
Washington, D.C. 20319-6000

3. DISTRIBUTION/AVAILABILITY OF REPORT

Distribution Statement A: Approved for public
release; distribution is unlimited.

5. MONITORING ORGANIZATION REPORT NUMBER(S)

Same

7a. NAME OF MONITORING ORGANIZATION
National Defense University

7b. ADDRESS (City, State, and ZIP Code)
Fort Lesley J. McNair
Washington, D.C. 20319-6000

8a. NAME OF FUNDING/SPONSORING
ORGANIZATION

8b. OFFICE SYMBOL
(if applicable)

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c. ADDRESS (City, State, and ZIP Code)

10. SOURCE OF FUNDING NUMBERS

PROGRAM
ELEMENT NO.

PROJECT
NO.

TASK
NO.

WORK UNIT
ACCESSION NO.

11. TITLE (Include Security Classification) *Standardization of Automatic Test Equipment
in the U.S. Air Force*

12. PERSONAL AUTHOR(S) *Arthur J. Rooney, Jr.*

13a. TYPE OF REPORT
Research

13b. TIME COVERED
FROM *Aug 91* TO *Apr 92*

14. DATE OF REPORT (Year, Month, Day)
April 92

15. PAGE COUNT *33*

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD GROUP SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

SEE ATTACHED

DTIC
SELECTE
MAR 30 1993
S B D

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT

☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL
Judy Clark

22b. TELEPHONE (Include Area Code)
(202) 475-1889

22c. OFFICE SYMBOL
ICAF-FAP

ABSTRACT

Standardization of Automatic Test Equipment in the USAF

Lt Col Art Rooney

The USAF has failed to standardize automatic test equipment (ATE) used to support aircraft avionics systems. Although the savings from standardization are difficult to estimate, studies indicate the Air Force could save over \$200M through standardization of ATE. Aside from the monetary savings, other benefits such as reduced training requirements and provisioning fewer items could be realized through standardization.

This paper will focus on three areas. First, we will look at standardization from definition through highlighting the importance of standard ATE. Next, a review of the impediments to achieving commonality of ATE within the Air Force. Finally, an actual example of acquiring common ATE for the Special Operations Forces will be examined.

The paper concludes with recommendations to achieve greater commonality of ATE within the Air Force.

1992
Executive Research Project
S79

Standardization of Automatic Test Equipment in the U.S. Air Force

Lieutenant Colonel
Arthur J. Rooney, Jr.
U. S. Air Force

Faculty Research Advisor
Lieutenant Colonel Robert A. Gustin, USAF



The Industrial College of the Armed Forces
National Defense University
Fort McNair, Washington, D.C. 20319-6000

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The Industrial College of the Armed Forces
National Defense University
Fort McNair, Washington, D.C. 20319-6000

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Introduction

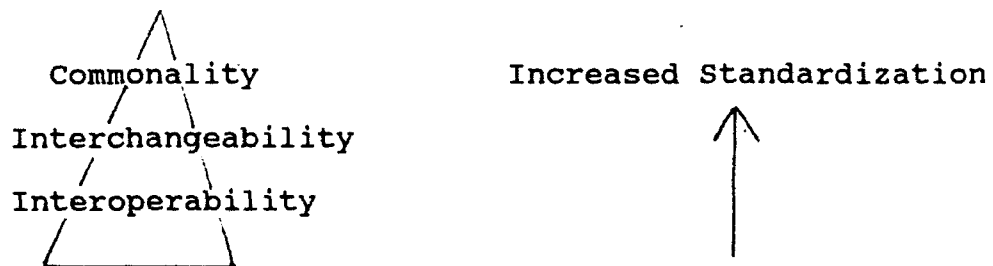
Standardization of automatic test equipment (ATE) is more important today than ever before. Significant budget constraints, recent combat experience (Desert Storm) and increasing reliance on joint operations with our allies demands increased commonality of equipment. In his book Out of the Crisis, Dr W. Edwards Deming argues that standardization was our number one weapon in World War II, and is responsible for providing the American consumer with lower prices, better quality, greater safety and more productivity (Deming 297). If standardization can be a weapon or force multiplier and reduce program cost, what actions are the Air Force taking to acquire standard automatic test equipment? What is standard automatic test equipment and why is commonality so important? These questions deserve serious consideration.

This paper will focus on three areas. First, we will look at standardization from definition through highlighting the importance of standard ATE. Next, a review of impediments to achieving commonality of ATE within the Air Force. Finally, an actual example of acquiring common ATE for the Special Operations Forces will be examined.

What is Standardization?

Standardization is "the process by which the Department of Defense achieves the closest practical cooperation among the services and defense agencies for the most efficient use of research, development and production resources, and agrees to adopt on the broadest possible basis the use of common, compatible, or interchangeable supplies, components, weapons, or equipment" (JCS 343).

The components of standardization are compatibility, interoperability, interchangeability and commonality. Figure 1 shows the components and degrees of standardization. Commonality is the highest degree of standardization (Keenan A-3).



Standardization Figure 1

Commonality is defined as "A quality which applies to material or systems: a. possessing like and interchangeable characteristics enabling each to be utilized, or operated and maintained, by personnel trained on the others without specialized training. b.

having interchangeable parts and/or components. c. applying to consumable items interchangeability equivalent without adjustment" (JCS 79). The importance of being able to operate equipment without additional training and the savings to be gained from having interchangeable parts or components will be discussed later in this paper.

The key to standardization is identifying opportunities among programs. The savings from standardization are difficult to estimate because it depends on a number of factors such as (1) the number of items standardized, (2) the development efforts avoided, (3) the quantities procured, and (4) the methods of procurement (GAO 8). When standardization is found to be appropriate, minimum savings of between 13% to 25% of the life cycle of non-standard equipment can be expected (LMI 53). Another study estimated that savings resulting from standardization could range from \$200 million to \$300 million (GAO 8).

Aside from the monetary savings, other benefits can be realized, such as: a. Fewer items need to be provisioned, cataloged, and stocked. b. Training requirements are reduced. c. Aircraft can be deployed faster using standard support equipment already in use at the deployment site.

DoD Standardization Policy

DoD 5000.2, Section Q, DoD Standardization Program, states that one of its' purposes is to "establish the basis for the efficient use of resources and the optimal reuse of the products of engineering efforts" (6-Q-1). It goes on to say that "When new material or practices are developed, they should satisfy multi-system and multi-service requirements" (6-Q-3).

Standardization Responsibility

Department of Defense (DoD) 4120.3-M, Defense Standardization and Specifications Program, Policies, Procedures and Instructions directs that the Defense Material Specifications and Standards Office (DMSSO) is responsible for:

a. Identifying areas of standardization opportunities, needs and/or conditions precluding standardization, and establishing priority areas for standardization efforts.

b. Assigning program management responsibilities for individual standardization areas to specific military departments/agencies. The standardization responsibility by Federal Stock classes and areas is found in the Standardization Directory (SD-1). The US Army Communications Electronics Command is responsible for automatic test equipment (SD-1 32).

c. Reviewing standardization area program plans and obtaining OSD approval.

d. Monitoring and evaluating the management of standardization areas.

e. Taking action to resolve problems and issues forwarded by the lead services (2-13)

The services were once required to submit a consolidated report to DMSO outlining standardization accomplishments and as minimum address the following topics: a. Reduction of items through item reduction studies. b. Participation with industry standardization bodies. c. Achievements in International standardization. d. Other significant standardization accomplishments (2-23). This requirement, however was eliminated as part of a Defense Management Review (DMR) initiative.

Air Force Standardization Policy

AF Regulation 800-28 establishes policy and assigns responsibility for acquiring and supporting components, equipment and systems. In Chapter 3, Avionics Policy, it states that "A prime consideration during the development of avionics standard items is the possibility of standardizing the support of various types of aircraft" (3-2).

ASJ/AX is designated the single Air Force organization responsible for focusing and controlling all Air Force avionics efforts. One of their many responsibilities is to "make sure the use of common avionics equipment in all new aircraft is considered. This organization is also the Air Force agent for identifying avionics standards and making sure they are used" (4-1).

Navy and Army ATE Acquisition

Both the Army and Navy have programs underway to acquire service common ATE. The Army tester is called the Intermediate Forward Test Equipment (IFTE). The Navy tester is called the Consolidated Automated Support System (CASS). These testers are designed to meet each services unique requirements. For instance, the Navy tester is designed for shipboard use and is capable of depot level repair of the black box. This supports their maintenance concept of maximum repair possible while underway. The Army IFTE tester is designed as a self contained unit to be transported on a truck or mounted on a trailer. These services approach to standardization are hardware oriented.

Air Force Automatic Test Equipment Acquisition

Unlike the Army and Navy approach to acquiring standard ATE, the Air Force has taken the approach of acquiring a system of standards called MATE (Modular Automatic Test Equipment). The MATE

System encompasses architectural interface standards and software required to provide the Air Force with procedures, technical tools, and facilities required to acquire and technically support Automatic Test Systems (ATS). It is in effect a management system supported by personnel and technical tools.

The MATE Program Office estimates that this program will save \$775M over the life-cycle of the 50 existing programs baselined thus far. These savings are a result of the following:

- A continuity of lessons learned. Because of standard software and architecture, a problem corrected on one system will be fixed on others.

- Re-use of system assets and spares.
- Common personnel training and support.
- A 95% control and support software transportability to all MATE stations.

- Operational Flexibility. Modifications to the system to accommodate technical advances can be performed with relative ease.

- Standard control and support software will be maintained by the Air Force.

- MATE modules can be competed resulting in lower costs.
- Reduced life-cycle costs.

Impediments to Standardization

The MATE program is not without problems. An FY93 PBD

(Presidents Budget Decision) 163 has zeroed out the entire MATE RDT&E funding line. It stated that MATE is outmoded and directed the Air Force to pursue procurement of Army IFTE and Navy CASS systems. OSD, specifically, the Assistant Secretary of Defense for Production and Logistics, believes the Air Force should utilize the Army IFTE or Navy CASS testers. The Air Force did RECLAMA this action citing technical limitations of the other services testers and projected \$462.5M in lost savings to AF programs that are about to enter development such as small ICBM testers. OSD accepted the RECLAMA but did not restore funding to the program. The Air Force has funded this program internally for the remainder of the fiscal year (1992). Without OSD support, this program will end this year.

This is not the first time that the Air Force approach has been questioned. In FY89, the Senate Armed Services Committee (SASC) expressed concern "about the cost of redundant efforts by the services to meet similar requirements" (149). The committee directed the Air Force to evaluate the ARMY IFTE program and report results by 1 Mar 89. The Air Force responded that the tester did not meet its operational requirements.

The MATE program lacks teeth. AFSC/AFLC Regulation 800-23, Policy for MATE, directs that "organizations that acquire, modify, or replace ATSS for logistics support will use MATE system procedures unless a waiver is granted" (2). However, there is no process to insure each weapon system program office complies with

this direction. The DoD IG recently found that AF program managers for 11 of 37 weapon system programs were acquiring ATE without the required MATE program approval or waivers (3).

This regulation also requires MATE system focal points to review "Request for Proposal (RFP) documentation from program offices early to insure MATE requirements are included" (3). Again, the DoD IG found that this was not being accomplished as many program managers were not aware the MATE program existed (4).

DoD 5000.2, Part 7, Section A, Integrated Logistics Support, does not place emphasis on standardization of support equipment. It does, however, charge each program office with "Identifying the most cost-effective approach to supporting the system when it is fielded" (7-A-2). NATO standardization and interoperability requirements are addressed under Milestone II considerations. The draft Air Force Supplement 1 to this directive does require support equipment to be acquired in the following order: (1) Standard item. (2) Preferred item. (3) Items already in the Government inventory or being developed under government contract. (4) Commercially available items that meet technical and logistics requirements. (5) Modifications of any of the above. (6) Development of new items.

Program managers need visibility of existing support equipment in the DoD inventory. The Air Force lacks visibility over support equipment requirements to preclude buying unnecessary equipment or

to further opportunities to achieve commonality between weapon systems. The program office could breakout the test equipment and provide it to the contractor as government furnished equipment (GFE). GFE is defined as "items in the possession of or acquired directly by the Government and subsequently delivered to or otherwise made available to the contractor for integration into the system or equipment" (Dillard 2). Program offices should have the information necessary to tell the contractor the ATE they prefer instead of routinely accepting the contractors support equipment recommendation.

Later in this report, you will see that there is little visibility of support equipment acquisitions within the same system program office. The MC-130H program office was acquiring one ATE system yet another program office within the SOF SPO recommended another ATE system. This is not always the case however. The B-1B SPO worked hard to reduce support equipment costs by utilizing ATE from the F-16 program. Since the B-1B and F-16 radar systems are essentially the same the test equipment could be used resulting in a tremendous savings (L'Ecuyer 64).

Earlier intensive test equipment management is needed to achieve commonality. An estimated 70% of the life cycle costs of a system is essentially locked in early in the conceptual phase when the concept is defined. Optimum use of the same ATE on several aircraft requires early identification and evaluation of

the opportunities. Unfortunately, logistics is a low priority early on in a program. Maj General Monroe T. Smith, chairman of the Support Equipment Acquisition Review Group, stated that although support equipment was critical to the mission of weapon systems it frequently did not receive the same priority and attention given to weapon systems (Support i).

Standardization is not one of the integrated logistics support (ILS) elements for consideration in the Air Force. The Army, however, has included standardization and interoperability as one of their 12 elements of ILS.

Public law may also preclude a program manager from acquiring a common tester. The Competition in Contracting Act (CICA) was enacted as Title VII of the Deficit Reduction Act, Public Law 98-369, July 1984. It represents the culmination of several years of procurement reform within the federal government. CICA's main purpose is to increase the number of competitive contract awards in the federal government. CICA established full and open competition as the standard for federal procurement.

CICA eliminated the 17 exceptions to formal advertising and establishes seven exceptions under which other than competitive procedures may be used. (A written justification and approval (J&A) is required for the use of other than competitive procedures.) The exceptions are: (1) Only one responsible source (2) Unusual and

compelling urgency (3) Industrial mobilization, or experimental, developmental or research work (4) International agreements (5) Authorized or required by statutes (6) National Security (7) Public interest.

Contractor attitudes and practices do not support selection of common ATE. Contractors are not incentivized to select standard ATE to support new weapon systems. They are interested in profits and follow-on business which precludes selection of ATE currently in the inventory. ATE is viewed as a "cash cow". Developing new ATE can cost more than several aircraft it is designed to support.

Problems can also be encountered when a contractor recommends a GFE tester. A lecturer, during AutoTestCon 90, reported that contractors often select a GFE tester which is most likely to impact schedule or performance. Problems encountered with the GFE tester result in claims against the government as well as extended interim contractor support (ICS).

Lack of integrated logistics support planning can also prevent selection of common ATE. Traditionally, ATE has been developed and acquired as part of the prime mission equipment acquisition process. The weapon system and support equipment design efforts are geared predominately to meeting a single aircraft program schedule and requirements. Little or no thought is given to developing or choosing ATE systems with applicability to more than

one weapon system. As a result, weapon system oriented acquisition approaches proliferate unique ATE. This approach will continue until the life cycle costs of support equipment is considered early in integrated logistics support process (ILSP).

When support equipment is acquired in the traditional approach to meet one weapon systems requirements, it is acquired as contractor furnished equipment (CFE). CFE is defined as "items acquired or manufactured directly by the contractor for use in the system or equipment under contract" (Dillard 3). This approach is most often used as the contractor is responsible for providing the test equipment on-time, functional performance and the technical interface with the black box. The added management cost of this approach does add significant cost to the support equipment.

A Time for Standardization

There is a greater need today than ever before for standardization within the services especially in the Air Force. On 16 Oct 91, Gen McPeak briefed the ICAF class of 1992 on the changing world and how the Air Force was changing as a result. The realities are that total obligation authority (TOA) will decline 37% over the next six years. There will also be a 27% reduction in manpower, 20% reduction in aircraft and a reduction of 24% installations. The Air Force of the future will truly have to accomplish more with less (McPeak).

The most significant change will be the organizational restructure. The restructure goals are to enhance combat capability and increase peacetime efficiency. These goals and the benefits of common automatic test equipment go hand in hand. The formation of the "Composite Wing" is one of the significant changes.

The composite wing will operate multiple weapon systems from the same base in a unified effort under a single commander. The operational concept calls for the autonomous , self-sustained, 24 hour conventional operations. It epitomizes the concept of "train like your going to fight" (McPeak).

Multiple weapon systems will be assigned to a composite wing including F-16, F-15, E-3, KC-10, B-52 and C-130 aircraft. There is even discussion of assigning AC-130U Gunships to the composite wing. Currently, there is no common intermediate ATE to repair these aircraft. Therefore, when these aircraft deploy as an autonomous unit, multiple pieces of test equipment will be required to support and maintain these weapon systems.

Composite wings are not actually new to the Air Force. The 1st Special Operations Wing at Hurlburt Field, Fl is composed of AC-130U and AC-130H Gunships, MC-130H and MC-130E Combat Talon, C-130H aircraft and MH-53J Pave Low helicopters. These aircraft are in various stages of acquisition or major modification. SOF

logisticians have long recognized the need for a common automatic tester to reduce the deployment signature as well as reduce proliferation of test equipment. The need was documented in a MAC Statement of Need (SON). A description of the attempt to acquire common test equipment follows.

Special Operations Forces ATE Acquisition

The Military Airlift Command (MAC) issued a Statement of Operational Need (SON) for a SOF Common Avionics Tester (SCAT) on 9 Jun 90. The SON highlighted that the MC-130E, MC-130H, AC-130H, AC-130U, MH-53J, MH-60G and CV-22 acquisition and modification programs all required the development of new support equipment. It called for the fielding of a single avionics tester to reduce proliferation of avionics testers, reduce support costs and increase deployability (Niedbalski. 1).

The SON went on to state that Air Force SOF units will deploy with units from other services who also have avionics intermediate level test requirements. Joint commonality with these units is desired to enhance covert deployability, availability, flexibility in addition to a reduction in overall cost. The SON, therefore, recommended that the candidate tester should include other services' common testers (Niedbalski. 1).

One candidate tester was the mobile electronic test set

(METS). This tester was first acquired by the Navy to support the AV-8B Harrier. The Air Force later acquired METS to support the F-15E aircraft. This tester was put to the test in Desert Storm. It was set up and repairing black boxes within 90 minutes of arrival, in a 110 degree plus hangar while using a very uncertain power source (Capaccio 12).

IBM selected RFMETS as the intermediate level tester for the radar on the MC-130H Combat Talon II aircraft in 1987. RFMETS is essentially the METS tester with radio frequency (RF) repair capability. Therefore, this tester could be used to repair the MC-130 radar, F-15E systems as well as systems on the AV-8B.

Another SOF weapon system, the AC-130U Gunship, was also beginning the acquisition process. Rockwell is the prime contractor. The contract contains a Not to Exceed (NTE) price of \$40.5M for contractor furnished equipment to support intermediate and depot level repair. Therefore, the contractor is incentivized to recommend government furnished equipment (GFE) as this cost would be born by the government. Nowhere in the contractors statement of work (SOW) is there a requirement to select a common or standard test equipment with other SOF programs. Section A1042 of the SOW requires the contractor to "Prepare Support Equipment Recommendation Data (SERD) for each common and peculiar SE item not currently on the C-130H TA but required to support the AC-130U Gunship" (SOW 7).

The Program Management Directive (PMD), dated 1 Mar 90, directs Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC) to identify common support equipment that meets the users requirement for deployable I-level described in the MAC SON. It further requires that support equipment currently in use or planned for use by SOF weapon systems be given first consideration. The intent is to reduce support equipment proliferation and constrain additional facility requirements (Easley 8).

In May 90, Rockwell in a pre-support equipment requirement document (SERD) recommended CAST for the intermediate tester. CAST, built by Bendix, was originally designed for Air Force National Guard F-4 aircraft. Due to early phase out of the aircraft and a failure on the Air Forces' part not to exercise all contract options, there were 32 systems on contract with no requirement. At the time Rockwell recommended CAST as the GFE tester, the tester was 6 months behind delivery of the first unit with additional schedule delays anticipated by the program office.

Both the user, AFSOC, and San Antonio Air Logistics Center, SA-ALC, non-concurred with Rockwells recommendation. SA-ALC cited anticipated future support problems with the contractors proposed RF addition to the CAST tester. In addition, large amounts of precision measurement equipment would be required to support the system.

In Aug 90, the AFSOC/CC stated that "the fixed point for SOF commonality was established when the Combat Talon II program procured the RFMETS". He went on to say that fielding both RFMETS and CAST was a step away from commonality. The point was also made that since the F-15E already utilizes METS, this was an opportunity to further commonality within the Air Force (AFSOC/CC 1).

The issue of commonality was resolved during a SOF Summit in Aug 90. The purpose of the summit was to scrub program requirements and reduce program risk where possible. The SOF SPO agreed to acquire the users tester of choice. In Sep 90, AF/LEX directed ALD/CC to establish a single program office to orchestrate the four parallel acquisition efforts of a common tester including the AC-130U, AC-130H, F-15 and MC-130H weapon system programs (AF/LEX 2).

The SOF System Program Officer (SPO), Col Beggs, attempted to acquire RFMETS via a Navy Basic ordering agreement (BOA) on 6 Feb 91. There were no options to buy additional testers through the MC-130H acquisition program. The Navy had a BOA with E&S to acquire EETS which is the Navy version of METS. The letter to the Commander Naval Air Systems Command stated that the operational need dates required expedited action to provide organic support for the MC-130H and AC-130U aircraft. The long lead time for procuring the RFMETS hardware is the pacing event. Use of the Navy BOA was

the most responsive approach to satisfy the need of these FAD 1 weapon systems (Beggs 1). This acquisition approach was reviewed and approved by the Mr Benedict Kausal, Competition Advocate General, Asst Secretary of the Air Force (Acquisition) on 27 Feb 91.

A PMD was issued on 1 Apr 91 directing the formation of a centralized office for acquisition of METS/RFMETS to satisfy the intermediate level requirements of the MC-130H, AC-130U and AC-130H and other SOF aircraft as appropriate. The goal of this program is three fold: first, to provide a common intermediate and depot level test and diagnostic capability for the three weapon systems. second, to provide a readily transportable and adaptable support structure to minimize airlift requirements. Third, to coordinate similar on-going efforts to prevent duplication of effort and gain efficiencies (Easley 2).

The Navy, however, on 4 April 91 denied the SOF SPOs request to process the order under the Navy BOA. The rationale was the lack of justification for sole source. In spite of discussions with Adm Morris, Naval Contracting, the request was denied. Although lack of justification was cited as the reason for denial, many believed the reason to be an injunction being sought by Allied Signal. Allied Signal had filed an injunction in Federal court in an attempt to force the government to compete the requirement.

In an out-of-court settlement, Allied Signal agreed to withdraw their complaint provided the Air Force notify them within 24 hours prior to exercising any sole source contractual action for RFMETS.

The SOF SPO then began preparing a Sole Source Justification and Approval J&A for approval by Mr Welch, Asst Sec of the Air Force for Acquisition. The J&A was based on Exception 1, only one responsible source and no other supplies or services will satisfy agency requirements without substantial duplication of costs...not expected to be recovered through competition and unacceptable delays in fulfilling agency's requirements. The program office estimated a competitive procurement would require an additional 12-18 months and could result in additional costs of \$18M. The J&A was approved on 30 Dec 91.

Conclusions

1. The Air Force evolutionary approach to acquiring standard ATS lacks the top level management emphasis necessary to be successful.

2. DoD lacks a consistent policy among the services on acquiring ATE.

3. The services do not coordinate the procurement of ATE when

acquiring new weapon systems.

Recommendations

1. The GAO should conduct a follow up of the services efforts to increase standardization of ground support equipment of military aircraft.

2. SAF/AQ and AFMC/CC should place greater emphasis on acquiring standard ATE.

3. Standard ATE should be directed early in the development of new weapon systems.

4. Program managers should be required to report during program reviews, use of standard support equipment.

5. Contractors should receive favorable consideration for responding with suitable, standard ATE to support new weapon systems.

6. DoD should establish a focal point to pursue acquiring standard ATE.

7. The Air Force should establish a program office responsible for acquiring new and replacement ATE to support weapon

systems.

8. Multi-year contracts should be used to satisfy ATE requirements. A multi-year contract is one way to control ATE proliferation and increase standardization. This method also serves to lower costs as well as reduce the administrative burden of issuing several contracts.

9. ATE program offices should obtain the necessary data to compete as soon as possible. The data should include detailed manufacturing, process and assembly drawings, with the rights to use for competitive procurement.

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